

Four Corners Air Quality Task Force
Air Quality Effects Summary
May 2006

Visibility

Particulate matter and certain gases emitted into and traveling across the atmosphere cause hazy conditions that interfere with the ability of an observer to see landscape features. For detailed information on this phenomenon, see: <http://www2.nature.nps.gov/air/Pubs/visible.cfm>

The goal of the national Regional Haze Rule is “natural” visibility by 2064 (i.e., no human-caused visibility impairment). States must show progress towards this goal, specifically not allowing the clearest days to degrade and showing improvement on the haziest days. For more information on the national visibility program, go to:

<http://www.epa.gov/oar/visibility/index.html>

Under current conditions, Ship Rock, located 45 miles from Mesa Verde National Park’s Far View Visitor Center can be seen in bright clarity only about half of the time. For the period 1995-2004, there has been no trend in either the haziest days or the clearest days getting better or worse. Photographs of various visibility conditions at Class I areas (national parks and wilderness areas) are available at:

http://vista.cira.colostate.edu/improve/Data/IMPROVE/Data_IMPRPhot.htm

Human Health

Ozone at ground level and particle pollution are the airborne pollutants that are of greatest concern for human health. Ground-level ozone is created by a chemical reaction between nitrogen oxides and volatile organic compounds in the presence of sunlight. Ozone can cause and aggravate respiratory conditions including asthma and other lung ailments. In New Mexico, about 11 percent of adults have been diagnosed with asthma during their lifetime. The percent of children likely to be diagnosed with asthma during their lifetime is slightly higher. Between 1980 and 1995, asthma prevalence increased 75 percent. Repeated exposure to ozone can cause permanent lung damage.

Particle pollution, in the form of nitrogen oxides and sulfur dioxides, can lodge deep into the lungs and cause a variety of serious health problems, including upper and lower respiratory symptoms and diseases, acute and chronic bronchitis and heart disease. Hundreds of studies have found correlations between pollutants and health impacts leading to lost work days, hospitalization and even death. One study recently done in the region did find a correlation between increased ozone levels and emergency department visits.

For an Environmental Protection Agency publication entitled “Air Quality Index: A Guide to Air Quality and Your Health,” go to: <http://airnow.gov/index.cfm?action=aqibroch.index>

Mercury

Mercury is a byproduct of coal-fired combustion and other incineration, mining, trains, and some other industrial processes. Mercury emitted into the air can then deposit onto the ground and into water bodies close or far from the source. Forest fires can “re-emit” mercury that has been previously deposited. Past uses of mercury, such as fungicide application to crops, are also a component of the present mercury burden in the environment. Mercury accumulates and persists in the environment. It builds up in the tissues of fish, and fish consumption is the pathway of concern for human health. As a neurotoxin, in large amounts it can damage the brain, kidneys and lungs, and low-level exposure has been linked to learning disabilities in children. Mercury impacts fish health, and interferes with reproduction of fish-eating animals. An assessment of mercury risks and outreach program in southwestern Colorado is planned but not yet funded.

Additional information on mercury in the environment can be found in EPA's mercury study report to Congress published in December 1997 (<http://www.epa.gov/mercury/report.htm>).

All states in the Four Corners area have fish consumption advisories for various water bodies. There is no mercury-related health risk from swimming in these waters. Specific advisories for the 4 states can be found at:

http://www.gf.state.az.us/h_f/fish_consumption.shtml (Arizona)

<http://www.cdphe.state.co.us/wq/FishCon/FishCon.htm> (Colorado)

<http://www.nmenv.state.nm.us/swqb/Mercury.pdf> (New Mexico)

http://www.deq.utah.gov/Issues/Mercury/fish_advisories.htm (Utah)

There is one mercury monitor located in the region, at Mesa Verde NP. There have been high mercury concentrations monitored at this site, although 2004 (the latest annual average available) was lower. For annual averages nationally, see:

<http://nadp.sws.uiuc.edu/mdn/maps/>

For information on the Mercury Deposition Monitoring Network, see:

<http://www.sws.uiuc.edu/pubdoc/IEM/ISWSIEM2005-03.pdf>

Ecosystem Health

Sulfur and Nitrogen When sulfur and nitrogen are deposited via precipitation (wet deposition) or by dry deposition, a variety of ecosystem effects can occur. Sulfur deposition can have acidifying effects. Nitrogen deposition can have both acidifying and fertilizing effects. Both plant and animal community composition can be altered by these pollutants. Deposition can cause chemical changes in soil and trees, ultimately leading to a diminished capacity to fight infestations and disease. Sensitive soils can become saturated with nitrogen causing it to runoff into lakes; in addition, soil chemistry and nutrient cycling can be altered such that rates of decomposition and other microbial processes are unnaturally changed. The fertilization effects of nitrogen deposition (“nutrient enrichment”) are undesirable because they alter the natural occurrence, distribution and health of terrestrial and aquatic plants.

Acidification of lakes and streams can occur when excess nitrogen and sulfur is deposited to surface waters with low “buffering” capacity—where natural agents (soil, rocks, plants) have used (for nitrogen) or neutralized most or all of the acidity they can. Fish and other aquatic life

may become less healthy, growth may be impaired, and sensitive species may die as a result of acidification. In some Western high-elevation wilderness areas, spring snowmelt has caused episodic acidification. Acidification can cause toxic metals to become mobilized or “activated,” which can have detrimental effects on aquatic and terrestrial ecosystems.

Surface waters in the lower elevations of the Four Corners area are likely to be generally well buffered and therefore have a relatively high resistance to acidification. However, there may be isolated areas where soils and water may be sensitive to acid deposition. Lakes in the higher elevations may be extremely sensitive to acidification from deposition, as has been documented by long-term water chemistry monitoring by the U.S. Geological Survey. A recent Forest Service report detailed modeling analysis on White Dome Lake in the Weminuche Wilderness area and concluded that very small amounts of additional nitrogen or sulfur deposition would make the lake acidic. A study has also shown that acid deposition has affected surface waters of some high elevation lakes in northern New Mexico.

There is no information available on the effects of deposition on water or soils in Mesa Verde National Park. However, several published studies for arid areas in the Western U.S. (e.g., the Mojave Desert and California coastal shrublands) have documented the undesirable effects of excess nitrogen deposition on plant communities.

For information on dry deposition, see: <http://www.epa.gov/castnet/overview.html> (Clean Air Status and Trends Network)

For information about wet deposition, see: <http://nadp.sws.uiuc.edu/> (National Atmospheric Deposition Program)

Ozone Ground-level ozone is an invisible gas—a poisonous form of oxygen. In addition to health effects, ozone causes damage to vegetation. Leaves and needles can become discolored and weakened, sometimes falling early and being more susceptible to stressors (pests, drought, disease). The Forest Service has a national network for ozone biomonitoring (<http://fiaozone.net>). Their national map of ozone exposure shows high concentrations in the Four Corners area, and sensitive species occur in the Four Corners area. While there hasn't been much research on ozone damage to trees and plants in the area, the National Park Service performed a national assessment to assess the risk of ozone injury to trees and plants. Although ozone concentrations were elevated in the Four Corners area, the risk to vegetation in the area was estimated to be at low because of the generally dry conditions (dry conditions cause plant stomates to close, preventing ozone uptake). For information on the NPS ozone risk assessment, see: <http://www2.nature.nps.gov/air/Permits/ARIS/networks/ozonerisk.cfm>

Cultural Resources

While the mineralogy of the sandstone suggests potential susceptibility to deposition of acidic compounds, there have been no observations of damage.

Economic

There are many economic costs and benefits associated with air pollution, although most state environment departments do not have economists on staff to perform economic impact assessments on a local level. In addition to costs to industry to reduce air pollution, the U.S.

Environmental Protection Agency, in its regulatory proceedings, routinely calculates or discusses economic values for several effects of air quality changes:

- Human Health (mortality and morbidity)
- Visibility (use and non-use/existence)
- Ecological benefits (market/products, recreation, ecosystem services, non-use/ existence)
- Materials damage (cleaning, repairing or replacing man-made materials)

Ecosystem services, the benefits to human societies that are supplied by natural ecosystems, are essential to human societies. We depend on them to produce goods such as fuelwood, clean water and habitat for plants and animals. These services are essential to protect people from harmful ultraviolet radiation, detoxify and decompose wastes, generate and preserve soils, contribute to climate stability and maintain biodiversity. Ecosystem services can be impaired by air pollution, at a large cost and for an extended period of time. There are many efforts to determine how to estimate the monetary value of ecosystem services, but few available studies. See, e.g.: <http://www.esa.org/science/Issues/FileEnglish/issue2.pdf>. (Ecological Society of America)

<http://www.rff.org/rff/News/Features/What-are-Ecosystem-Services.cfm> (Resources for the Future). Also see this Forest Service website: <http://www.fs.fed.us/ecosystems-services/>

The Four Corners area is home to many tourist attractions, and air pollution can have an impact on tourism dollars as well. In surveys conducted at 30 national parks over a 10-year period, 89% of visitors said clean air (air quality, scenic views and visibility distance) was very or extremely important in the parks. This is likely to be very similar in wilderness areas. Other studies have linked reducing air quality to less visitor time spent in a park. In 2003, there were 438,590 visitors to Mesa Verde National Park, and using an established visitor spending model, it is estimated that they spent almost \$29 million in the local economy, including lodging, food, and sales; and not including secondary impacts in the form of sales taxes, jobs and incomes. In 2005 there were almost 500,000 visitors to the park. In the San Juan National Forest, there were 1.9 million visitors in 2001 (100,000 in the wilderness areas within San Juan NF), and there are 8 other national forests in the Four Corners area. There are no known studies in the region estimating economic effects on tourism from air pollution.